DOCUMENT RESUME

ED 380 085 IR 017 006

AUTHOR Jones, Marshall G.
TITLE Visuals for Information Access: A New Philosophy for Screen and Interface Design.
PUB DATE [95]
NOTE 10p.; In: Imagery and Visual Literacy: Selected Readings from the Annual Conference of the International Visual Literacy Association (26th, Tempe, Arizona, October 12-16, 1994); see IR 016 977.
PUB TYPE Information Analyses (070) -- Reports - Evaluative/Feasibility (142) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Change Strategies; *Computer Assisted Instruction; *Computer Graphics; Computer Interfaces; Computer Uses in Education; *Graphic Arts; Literature Reviews; Models; *Screen Design (Computers); Visual Aids; Visual Arts; Visual Learning
IDENTIFIERS Browsing; Examples; *Iconicity; *Paradigm Shifts

ABSTRACT

Computer-based instruction (CBI) has undergone tremendous changes in the past decade. This paper focuses on the following three areas of designing information presentation: (1) screen design literature is dated, and the existing guidelines do not allow for advances in computer technology; (2) open-ended guidelines may offer designers sufficient guidance for designing computer screens and user interfaces without stifling the creativity of the individual designer; (3) the paradigm of static screens has changed to one of active, interactive, screens filled with dynamic visual elements. The evolution of computer use and graphical user interface design, and the outdated literature are briefly described. Browsing is presented as a broad concept of interface design in computer-based learning environments, and seven guidelines for browsing are presented. Icons are proposed as a way in which CBI programs can use graphics (as opposed to the traditional redundancy between the object and the representational text.) Icons are considered dynamic, and are differentiated from static graphics because they show the user that a choice is available. Interactive graphics, animations, and interactive text are other examples of possible screen dynamics. This paradigmatic shift is a move away from thinking of screens as individual pieces of the program, and a move towards thinking of screens as thread that can hold the interface and the program together. Three figures illustrate a CBI program interface. (Contains 22 references.) (MAS)

Visuals for Information Access: A New Philosophy for Screen and Interface Design

Marshall G. Jones

Introduction

Computer-based Instruction (CBI) has undergone tremendous changes in the past decade. Changes abound in not only how the programs look, but in what the programs are intended to do. Most of us remember early pieces of CBI. They relied predominantly on text as the presentation medium, and interaction was limited to pressing the space bar to continue. These programs were linear in nature, and were limited in the types of information they could present, and the types of learning outcomes they could cover. Most of these programs were written for the computers that were available at that time. Computers such as Apple's IIe, and IBM compatible XT's were only capable of displaying minimal graphics, and relied predominantly on text. Interaction was limited in most cases to the available input device: the keyboard. Consequently, text based screens were controlled by keyboard commands.

With the advent of the first widely used graphical user interface (GUI) computer, the Apple Macintosh, in 1984, it became possible to do more sophisticated things with the computer. Graphics were easier to edit and include in programs. Old monochrome green or amber screens have yielded way for the high resolution display devices most of us use today. Additionally, input in nearly all computers today may be done not only from the computer's keyboard, but with the help of the track ball or mouse. Users can now not only click on the right arrow to continue, but also control the rate of presentation of digitized video and audio, manipulate data and information on the screen, and interact with the information in the program from a variety of perspectives. The way that computers may be used has changed drastically, and this change has had a dramatic impact on the use of computers as an instructional delivery system.

With the change in how computers can be used comes a change in how information appears on the screen. This paper focuses on the following three areas of designing information presentation:

1. Screen design literature is dated, and the existing guidelines do not allow for advances in computer technology;
2. Open ended guidelines may offer designers sufficient guidance for designing computer screens and user interfaces without stifling the

creativity of the individual designer;

3. The paradigm of static screens has changed to one of active, interactive, screens filled with dynamic visual elements.

The Literature is Dated

Heines (1984) wrote the book, literally and metaphorically, on screen design. For years his ideas were used by designers and teachers of designers used to guide their efforts in designing screens for CBI programs. While Heines' book served a great many people well for a number of years, his work was written relative to the available technology. This is also reflected in the lion's share of the research done in the area of screen design. Alessi and Trollip (1985); Bork (1987); Heines (1984); Hooper and Hannafin (1986); Issacs (1987); Morrison, Ross, O'Dell, Schultz, and Higginbothan-Wheat (1989); and Rambally and Rambally (1987) all conducted research in the area of textual manipulation as it applies to screen design. Once again, this literature is quite dated. The guidelines produced by this research suggested things such as never using itlaticized or bold text. This was certainly true for old monochrome screens, but the advice seems odd in the face of high resolution display devices.

Hooper and Hannafin (1988) and Hannafin and Hooper (1989) began looking at how the design of the screen could be used to promote and engage learners relative to individual learning styles. Keller and Suzuki (1988) proffered ways in which the screen could be used to motivate the user into using the CBI program. But all of these efforts were focusing on the screen as a static delivery system. A delivery system that would allow for the users to acquire information in a passive environment, sitting and reading and watching while they absorbed all of the designer ordered information in the program. While Jonnasen (1988) began to flirt with the notions of constructivism as it applied to CBI, and offered suggestions for how to engage learners in a more realistic environment, Grabinger (1989) began to look at the screens as a dynamic medium through his first efforts at multiple element research. But this research looked at the design of the screen as a static environment, and these guidelines provided designers with specific things to do when designing the screen. These specifics soon became outdated as technology rapidly out grew these recommendations.

User Interface Design

All of this literature focused on the design of the screen, and screens were seen as individual units linked together by proceeding through the information a screen at a time. However, in today's environments, windows overlap, multiple events can happen on the same screen at one time, and the user is faced with controlling not only a complex piece of software, but also a complex piece of instruction. Users control this complex environment through the use of the user interface (Jones, 1993). And while literature on the design of the user interface does exist, (Blaser & Zoeppritz, 1982; Schneiderman, 1987) it exists within the area of human computer interaction (Booth, 1989; Carroll & Moran, 1991; Diaper, 1987; Dumas, 1988; Eason, 1988) on topics such as system software design and application software design. Jones (1989) made an excellent effort in beginning to discuss user interface design in terms of CBI, but little else exists in the area of user interface design as it applies to educational software. The difference

between educational software and application software and system software is immense.

Eventually, given enough time and practice, anybody can learn any interface-even MS-DOS. We become intimately familiar with how our systems work. We know what different icons mean, what commands we need to copy, move, delete and rename files. In the applications we use daily, we are comfortable in doing the things we need to do, and in experimenting with the software to do new things. We use these things almost daily. However, CBI is a one shot deal. The purpose of the software is not to create lifetime users. The purpose is to get the users into the program, teach them the things they need to know, and then get them out. Instructional and educational software is not used on a daily basis. Using the interface becomes more important because users need to understand it almost instantly.

Laurel (1991a; 1991b) has provided us with the most recent articulations of what user interfaces should do, but once again this focuses on areas that are not directly related to educational and instructional software. While it is possible to extrapolate much of this information to be applied to the design of educational and instructional software, the problem remains that there is a dearth of research into how the screen in a CBI program can incorporate a dynamic interface to promote the acquisition of knowledge to the end of promoting and improving human learning.

Broad Concepts Of Interface Design

Technology will move beyond any set of specific set of do's and don'ts for the design of the screen or the design of the user interface (Jones, 1993). While today we wrestle with digital video and multiple window, tomorrow we will be faced with virtual reality. All of these changes effect not only what the computer can do, but what can be done with education as it is delivered on the computer.

Programs such as IBM's *Illuminated Books and Manuscripts*, and *Columbus: Encounter, Discovery, and Beyond*, pushed the envelope of not only what had been done before technically, but in what educational software could be. While Heines (1984) recommended that screens have specific functional areas, or areas on the screen where information could always be found, these programs used overlapping windows and presentation areas that required the user to manipulate the information on the screen. These dynamic programs make it nearly impossible to say where things should go on the screen. As with any multiple windowed environment, it is ultimately the user who will decide what window is displayed, and when it should be displayed. And it is this new found control by the users that may drive a shift in paradigms from designer driven instructional delivery to user driven instructional delivery.

Jones (1993) proposed a set of guidelines for the design of user interfaces in computer-based learning environments. These guidelines do not offer the user do's and don'ts about what to do and when to do it (Hill, 1994), but, rather, offer the designer a set of issues to consider when designing the screens and ultimately the user interface for computer-based learning environments.

For example, one concept of interface design is browsing. Browsing allows for the flexible exploration of the content of the program through a variety of con-

trols. Browsing can be done topically by providing users with a list of the topics covered in the program through the use of a menu (See Figure 1). Once a topic is selected, users can use methods such as clicking on right and left arrows to access related or extended material. While browsing should be flexible and exploratory, it should not be indiscriminate or uncontrolled. Users need to be able explore the program for new information, know where they found it, and be able to find it again. One common method of providing for browsing in a computer-based learning environment is through the use of menus, (See Figure 1) lists of navigational and informational choices, and right and left arrows, buttons on the screen designed to take the user to the "next" or "previous" screen (See Figure 2). With the advent of the GUI, and the power of the modern authoring systems, it is now possible for users to browse through the use of terms entered on the keyboard, through clicking on "hot word" as in a hypertext environment, by choosing from pop-up menus, or by clicking on a portion of a graphic to take the user to a variety of places. These interface elements are illustrated in Figure 3.

The guidelines for browsing are presented below. While there are other concepts of interface design (Jones, 1993), this example is included to illustrate what the concepts of interface design are intended to be, and, when coupled with the included figures, how they might be implemented.

Guidelines for Browsing

1. *Provide selectable areas to allow users to access information.*

Some possible selectable areas to consider are buttons and hot text within a text field. The location of these elements on the screen will depend on the available screen real estate and the function of the selectable areas. It is recommended that the placement of selectable areas be tested with users to find out what is the optimal location for them. The selectable area will be a control element for users to access information. The control chosen will depend on the task to be done. Be consistent in implementing particular controls for particular functions.

2. *Allow users to access information in a user-determined order.*

This may be done through topic indexes of all of the information available in the program, or through the use of different types of menus. Another technique to consider is allowing for user-entered search terms. Exploration should be flexible, and the controls for accessing information should reflect flexibility.

3. *Provide maps so that users can find where they are and allow provisions to jump to other information of interest from the map.*

Because the content of computer-based learning environments tends to be complex, using visual or iconographic maps may be too difficult to include and too confusing for users to understand. What we now consider as maps may have to change drastically. Text based indexes, outlines, and tables of content may be considered as alternatives to maps.

4. *Provide users with feedback to let them know that they must wait when significant time delays are required for the program to access information.*

Many programs use watch cursors, or text messages that ask users to "be patient." Another technique to consider is to offer users some type of visual stimulus to maintain their interest while the computer is preparing to present the requested information. However, visual

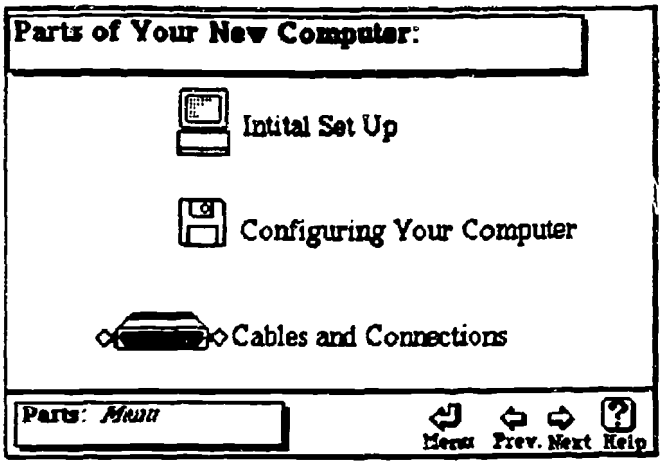

Figure 1. Browsing through a CBI program through the use of a menu.

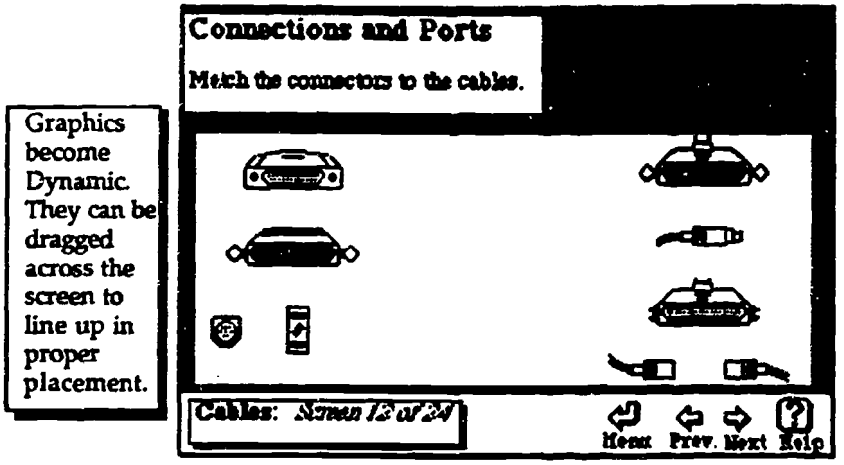

Figure 2. Browsing through a CBI progam through the use of right and left arrow keys.

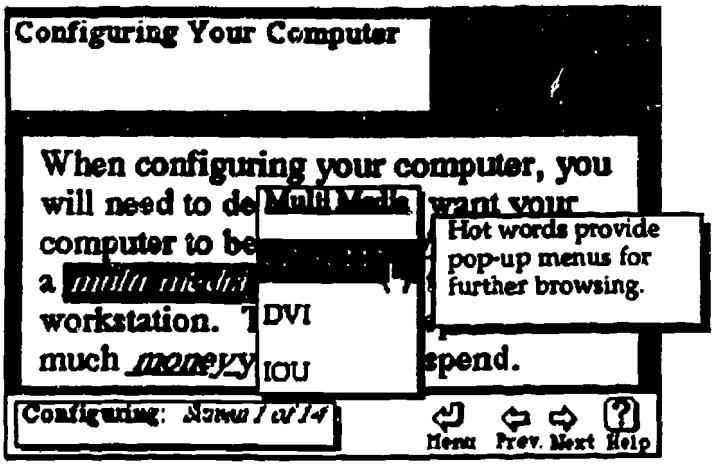

Figure 3. Browsing through the interface by clicking on "hot text" and "pop-up" menus.

stimulus should be chosen carefully and kept as simple as possible.

5. *Provide users with information that lets them know that they are making progress.*

Because the information in computer-based learning environments is not organized sequentially, there is no determined order that users must follow through a program. Consequently users may feel that they are working in a program without making progress. Some techniques that may be considered to give users a sense of accomplishment are path history mechanisms that tell users what information they have seen, or visual cues that indicate progression. Another technique would be to break the program up into chunks that may give learners a feeling of accomplishment.

6. *Arrange information in a non-threatening manner so that users are not overwhelmed by the amount of information contained in a program.*

To accomplish this consider setting up information with an overview of a topic that acts as a top layer of information. As users need more information they can move progressively deeper through the layers of information. Moving through the layers of information could be done through the use of pop-up menus, buttons, or hot text.

7. *Provide visual effects to give users visual feedback that their choices have been made and registered by the program.*

Buttons, icons, and menus can be highlighted or animated to show users that a choice has been made. Keep the highlighting or animation simple. The duration of a highlight or animation should be long enough to be registered visually by the users, but short enough so that users are not waiting for an animation to be over so that they can get to the information they want.

Visual effects, such as wipes, fades, and zooms may be used to indicate access to a particular piece of information. The use of these visual effects should be consistent. Do not use them simply because they are available, but rather use them to indicate a particular action of the program. Additionally, be consistent in the use of a visual effect. If wipes are used when clicking on a right arrow, use them throughout the program. If zoom outs are used when clicking on a menu item, then use zoom ins when returning to the menu. Above all, make the visual effect have meaning and be consistent with its use throughout the program.

A New Paradigm for the Design of User Interfaces

Reiber (1994) makes the distinction between static graphics and animation. While this distinction is quite true, it fails to take into account the possibility of *dynamic* graphics. Dynamic graphics can be found throughout the computer-based learning environment. Graphics are traditionally thought of as a separate element of the screen. The purpose of the graphic has been to offer significant redundancy between the object and the text used to describe it. While this was true for early pieces of CBI, today's programs use graphics in a variety of ways beyond simply illustrating a point. Icons are a poignant example of this.

Icons are used to indicate to the user that a choice is available. Left and right arrows indicate that users may go "next" and "previous", hooked arrows indicate that a return to the previous menu is possible, question marks may represent the availability of on-line help, and directional arrows may offer the user the chance to see a map to help

them decide where they want to go. While these graphics may be static, they are in fact dynamic as well. They show the user that a choice is possible. When they are selected, they may be highlighted to indicate that a choice has been made. When they are clicked upon, something happens: the user is carried to a different point in the program. The choice of what icon to use, whether or not to label the icon, and what icons are appropriate for a particular learning environment are of paramount importance.

Additionally, graphics may be interactive. Scanned images and clip art can have buttons layered over them, offering the user the chance to explore an image and receive further information.

Animations can obviously offer the user a dynamic element in the program. While research has shown no significant difference in the use of static graphics versus animation (Reiber, 1994), it is generally recognized that the use of animation can offer many subtle benefits (Reiber, 1994). When the animation is congruent to the learning task, it can offer instructional benefits to the learners (Reiber, 1990).

Graphics are not the only elements of the screen that can be dynamic. Text can also provide the users with options, choices, and navigational cues (Kahn & Landow, 1993). While text on the CBI screen has traditionally been used as a passive medium, it is now possible for the text to be an active part of the screen. Text formatting such as underlining, bolding, and italicizing can provide users with a different type of visual to be used when accessing information. The user can click on text to view graphics, see further textual information, activate a link to another section, and to activate a pop-up menu (See Figure 3).

The point is that the computer is a dynamic medium. Authoring systems make it possible for non programmers to develop remarkably sophisticated programs which are interactive and kinetic. Consequently, designers need to provide opportunities for the user to take advantage of its potential.

The paradigmatic shift that I am suggesting is one where we move away from thinking of screens as individual pieces of the program, and move towards thinking of screens as the thread that can hold the interface, and, ultimately, the program together. Deciding on a theme for a program can help designers pull the thread through the interface, providing the user with controls, displays, and informational elements which can keep the user interested, help the user find out where they are, and ultimately aid the user in the complex process of taking the information out of the program and integrating it into their own conceptual knowledge base. In short, the interface should not only guide the user and present information, but help in the process of promoting and advancing human learning.

References

Blaser, A. & Zoeppritz M. (1983). *End user systems and their human factors*. Berlin: Springer-Verlag.

Booth, P. A. (1989). *An introduction to human-computer interaction*. London: Lawrence Erlbaum Associates.

Carroll, J. M. & Moran, T. P. (1991). Introduction to this special issue on design rationale. *Human-Computer Interaction*, 6, 197-200.

Diaper, D. (1987). *Task Analysis for human-computer interaction*. Chicester, England: E. Horwood

Dumas, J.S. (1988). *Designing user interfaces for software*. Englewood Cliffs, NJ: Prentice-Hall.

Eason, K. D. (1988). The user in a sociotechnical system. In N. Heaton & M. Sinclair (Eds.), *Designing end-user interfaces*. (pp. 25-37). Maidenhead Birkshire: Pergammon Infotech Limited.

Grabinger, R. S. (1989). Screen layout design: Research into the overall appearance of the screen. *Computers in Human Behavior*, **5**, 175-183.

Hannafin, M. J., & Hooper, S. (1989). An integrated framework for CBI screen design and layout. *Computers in Human Behavior*, **5**, 155-165.

Heines, J. (1984). *Screen design strategies for computer-assisted instruction*. Bedford, MA: Digital Press.

Hill, J. (1994). Interface design for multimedia instruction. *Tech Trends*, 39(3), 25-26.

Hooper, S. & Hannafin, M. J. (1986). Variables affecting the legibility of computer generated text. *Journal of Instructional Development*, **9**(4), 22-28.

Hooper, S. & Hannafin, M. J. (1988). Learning the ROPES of instructional design: Guidelines for emerging interactive technologies. *Educational Technology*, **28**(7), 14-18.

Issacs, G. (1987). Text screen design for computer-assisted learning. *British Journal of Educational Technology*, **18**(1), 41-51.

Jonassen, D. H. (1988). Integrating learning strategies into courseware to facilitate deeper processing. In D. Jonassen (Ed.), *Instructional Designs for midrocomputer courseware*. (pp. 401-434). Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.

Jones, M. G. (1993). *Guidelines for Screen Design and User Interface Design in Computer-based Learning Environments*. An unpublished doctoral dissertation at the University of Georgia, Athens Georgia.

Jones, M. K. (1989). *Human-computer interaction: A design guide*. Dubuque, IA: Brown and Benchmark.

Kahn, P. & Landow, G. P. (1993). The pleasures of possibility: What is disorientation in HyperText?. *Journal of Computing in Higher Education*, 4(2), 57-78.

Keller, J. M. &Suzuki, K. (1988). Use of the ARCS motivation model in courseware design. In D. Jonassen (Ed.), *Instructional Designs for midrocomputer courseware*. (pp. 401-434). Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.

Laurel, B. (1991a). *Computer as theatre*. Menlo Park, CA: Addison Wesley.

Laurel, B. (Ed.). (1991b). *The art of human-computer interface design*. Menlo Park, CA: Addison Wesley.

Rieber, L. P. (1990). Animation in computer-based instruction *Educational Technology Research and Development*, 38(1), 77-86.

Rieber, L .P. (1994). *Computers, graphics, & Learning*. Englewood Cliffs, NJ: Prentice-Hall.